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(p.s. Reply to LaMere@I4-TENEX

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From: JEANNETTE at USC-ISIB

Subject: Facts on DOD Supported Network Study and The ARPANET

To: Licklider at ISI, Russell at ISI, Blue at ISI

cc: Uncapher

The following represents a set of factual observations regarding background research which culminated in the ARPANET, its use, and impact. Together they represent a collection of aspirations and contributions which ARPA can point to with pride and an immense sense of accomplishment. This might be useful in light of the current press statements about the Net.

In the early 1960's, the Air Force under Project RAND funded the design of a U.S.-wide communication net which could remain at least partially operational in the face of a heavy nuclear attack -- a ~~serious threat perceived at that time.~~

use to be formed by linking commercial radio stations in times of national emergency. The concept was interesting but not reliable enough or cost effective enough to warrant any investment beyond the bounds of the small study.

The next attempt, again in the early 1960's, was based on the following basic principles:

- 1) Digital integrated circuits were becoming very inexpensive.
- 2) Small computers made up from integrated circuits could control the routing of messages, correct transmission errors and could manage adaptively the rerouting of messages around line outages caused by common failure or by nuclear attack.
- 3) The notion of an all digital U.S.-wide network made up of about 200 small computers (the nodes) linked redundantly to other neighboring nodes by radio links, telephone links, T-1 carrier links and satellite links seemed attractive and possible.
- 4) Extensive study, emulation, and modeling proved that the concept of an adaptive digital store and forward packet switched U.S.-wide network would provide:

A survivable military network, capable of sustaining a heavy nuclear attack and still remain partially operational.

A net which would substantially improve reliability of fundamental military communication.

A net which, inherently because of its digital nature, could protect information in a military security sense.

A net which could take optimum advantage of low cost micro electronics and could serve as proof of the value of using very low cost "thrown away" electronics effectively due to the redundant nature of the fundamental system design.

Although not explicitly stated, the net design represented the first computer-managed, computer-controlled, digital store and forward net. The effort resulted in a rather complete treatise called "On Distributed Communications" by Paul Baran, et al. (Baran, Paul. "On Distributed Communications: Vol. I-X." The Rand Corporation, August, 1964.)

The "On Distributed Communications" (ODC) concepts were rather revolutionary and not well understood by the computer community and poorly understood by the traditional analog communications community.

Interest in implementing the ODC net dwindled in the mid 60's as the threat of nuclear war involving U.S. soil diminished.

The Air Force started two efforts after 1965 to test the ODC concepts but neither was funded long enough to produce results.

As an aside, the ODC concept sparked the notion of both the threat to personal information and a method of protection of the information--

About 1968 Dr. L. W. Roberts, then at ARPA, devised a concept of a large resource sharing U.S.-wide net based partly on ODC concepts and partly on newer concepts of his and his colleagues.

The design, implementation, testing and use of the net carried with it all of the initial military goals and aspirations of the ODC objectives plus the following:

- Global resource sharing of a variety of network based services.
- Reduction of the cost of communication.
- Creation of a network to support data traffic and to make it economically feasible to send information (data) on a cost-per-bit basis independent of time and distance.
- Expansion of the power and utility of the integrated circuit and the computer to communication of data.
- Great improvements in the number of bits which could be sent error free.

Although the Net research and development was to provide a new technological base for ultimate military requirements, the ARPANET from its conception to fully operational form and still today has remained unclassified, openly discussed, and reported in several proceedings of AFIPS Joint Computer Conference and publicly demonstrated on many occasions.

The ARPANET has remained totally unclassified in concept, in implementation and in use.

The ARPANET's major contributions are:

- A working, useful prototype for a digital store and forward U.S.-wide net packet switched network.
- A superb demonstration of the economic and productive aspects of global (U.S.) sharing of computer resources.
- vastly improved reliability of the transfer of large amounts of information over the net.
- The conception (in a major way) of the ability to protect information, in a privacy and security sense, well beyond that of other techniques and at lower cost.

The net has proven itself to be such an impressive prototype of future digital nets and it has:

- Greatly influenced the design of future military networks.
- Spawned a valuable common carrier business in the U.S. as fallout.
- Resulted in similar experimental nets being established in Spain, U.K., France and in serious consideration of ARPANET-like communication systems by other foreign

... research community as a tool which provides greatly enhanced communication between research projects and greatly reduced costs of computer hardware and software due to the impressive level of resource sharing allowed on a national scale (to the point that ARPANET technology is as fundamental a tool as the computer itself).

The focus and responsibility of ARPA is, of course, the advanced research arm of the Department of Defense. Its function is to greatly enrich the U.S. technological base in support of short and long term military needs and aspirations. The ARPANET project in 1969 represented a high risk, potentially high impact research effort. The existence of the Net in practical, useful form has not only provided a communication technology to meet many short term military requirements, but it represents a formidable communication technology and experience base on which the military will depend for advanced communication needs. Confirmation of this is becoming evident in many DOD-military planning documents.

In summary, the ARPANET project has provided a solid technological base for many future military communication requirements. It has placed the U.S. in a leadership position in computer-managed, computer-controlled packet switched network technology. The technology has been observed by other agencies and, for some of them, forms the basis for future communication. Throughout the entire development of the Net, ARPA has been able to be extensively responsive to DOD-military need while keeping the Net, the research supporting it, and the results open, unclassified, and documented largely via professional society publications.

In addition, the ARPANET is the product of ARPA and a large collection of highly collaborative and cooperative university, non-profit, and profit organizations via which a strong, diverse experience base has been generated which must, and has, placed this country ahead of all others in advanced digital communication science and technology.

P.S. Estil isn't very knowledgeable re history of the Net. It would be useful for him to have a copy of the above, but I feel it should be your decision.

Keith
